

FIG. 1

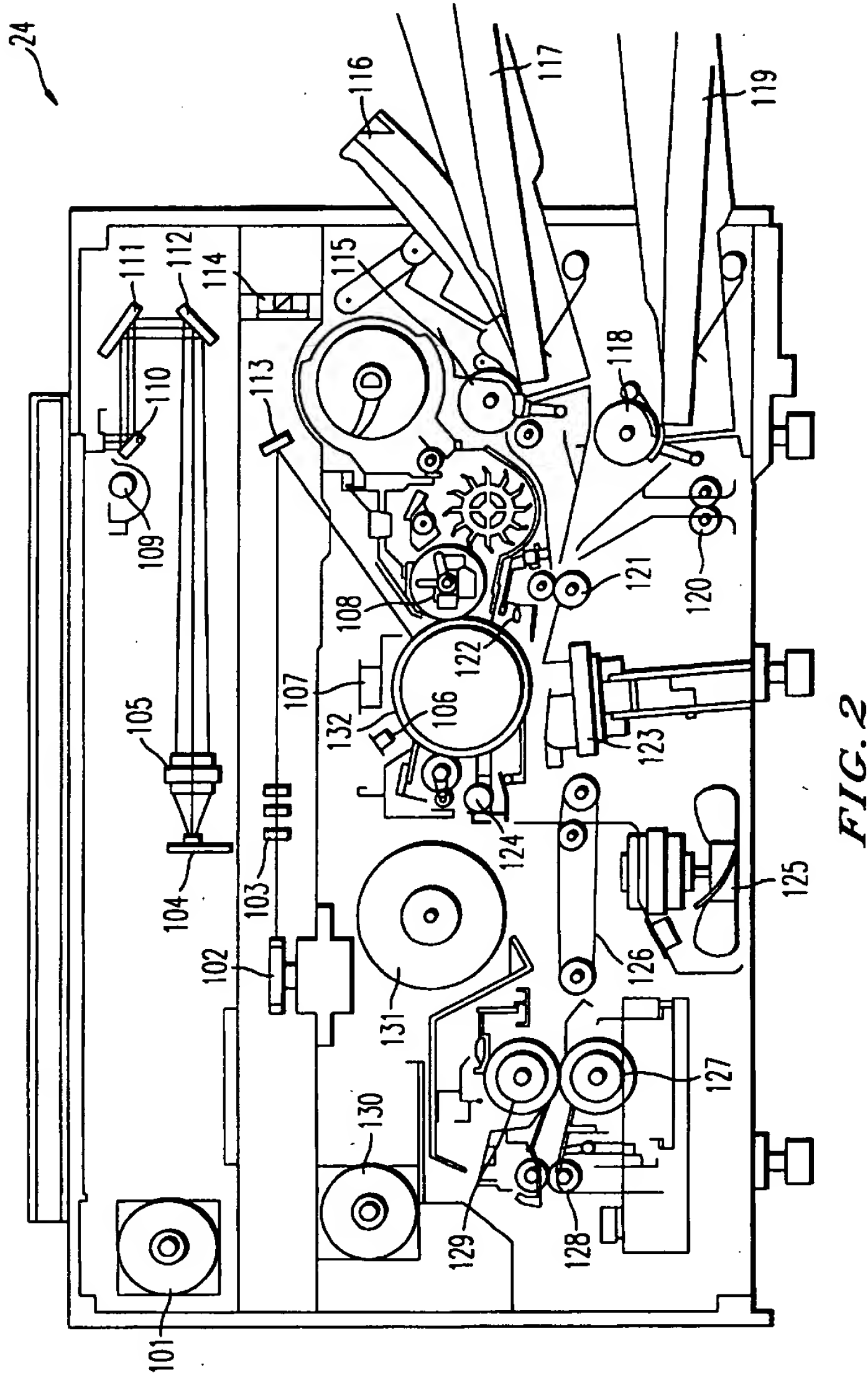


FIG. 2

SECRET



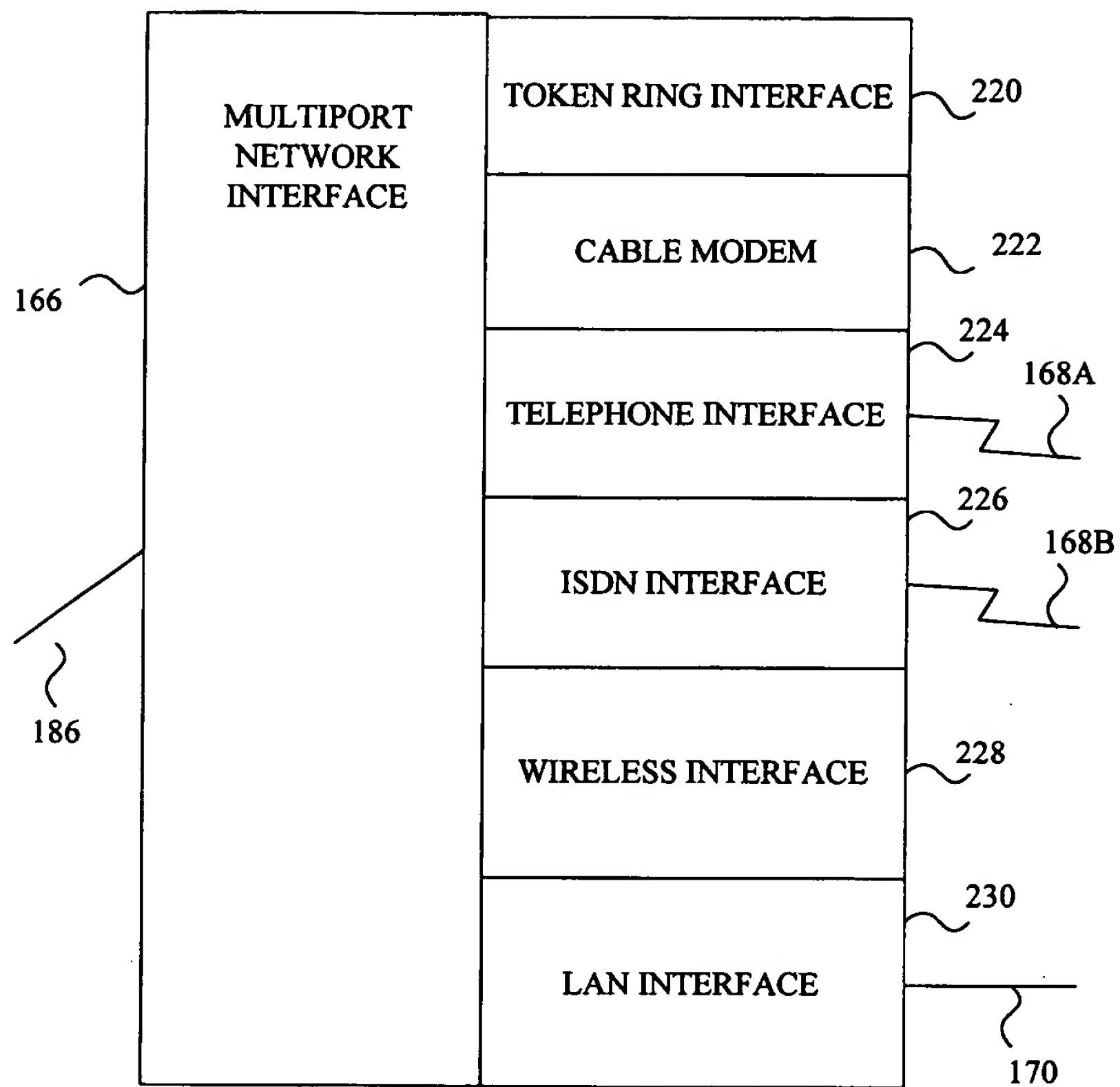
[illegible]

FIG. 4

DISCUSSION

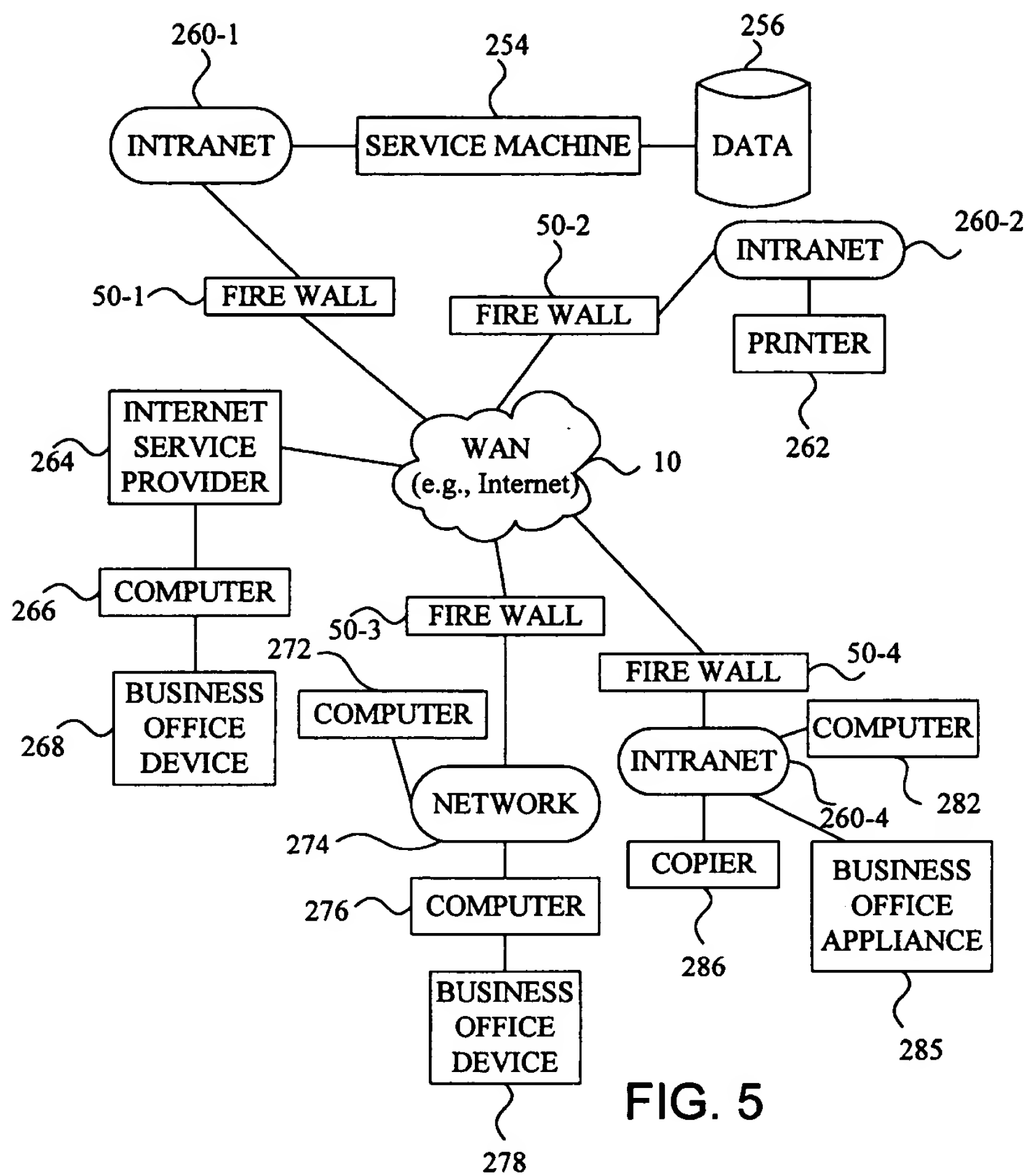


FIG. 5

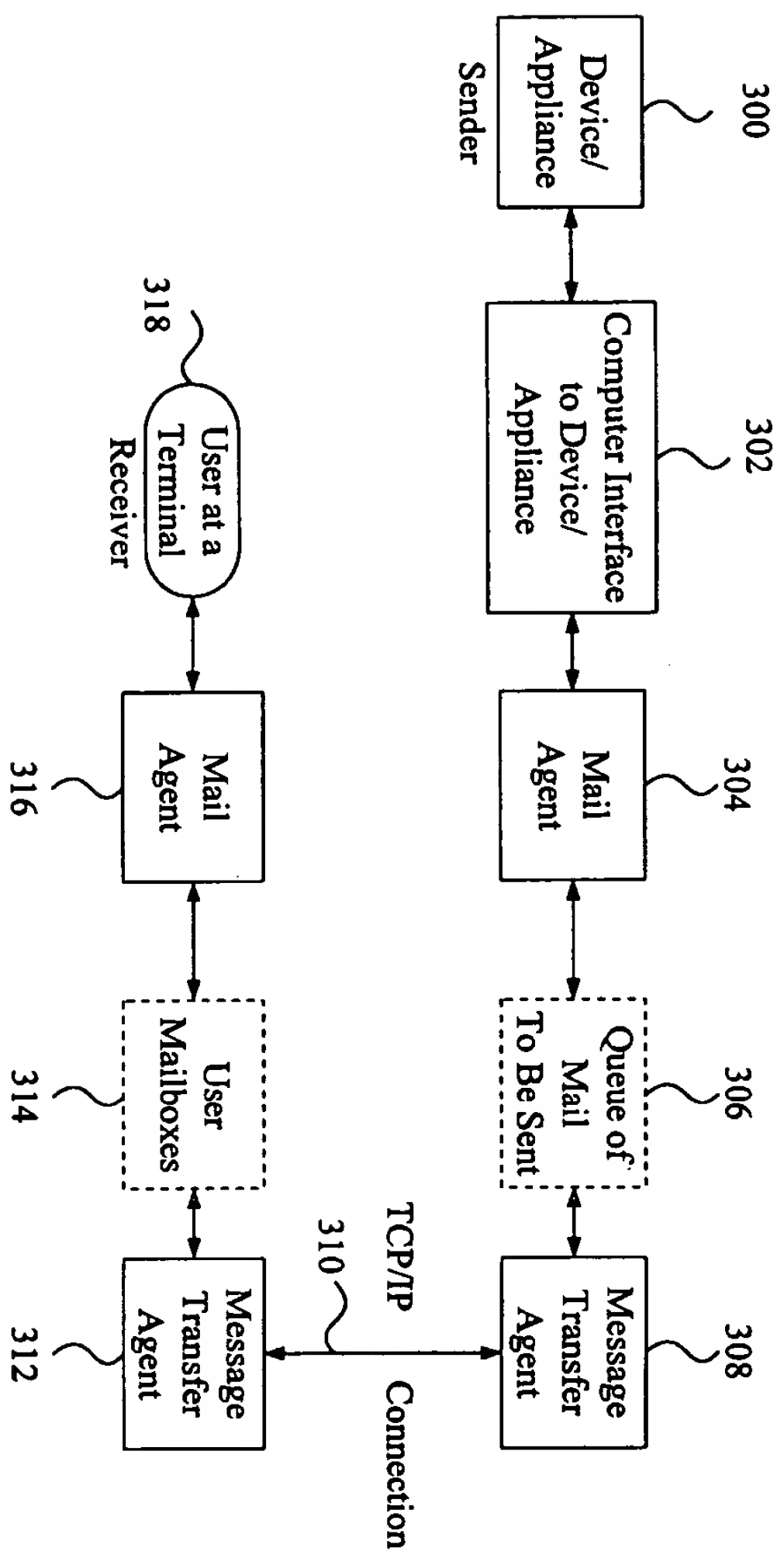


FIG. 6A

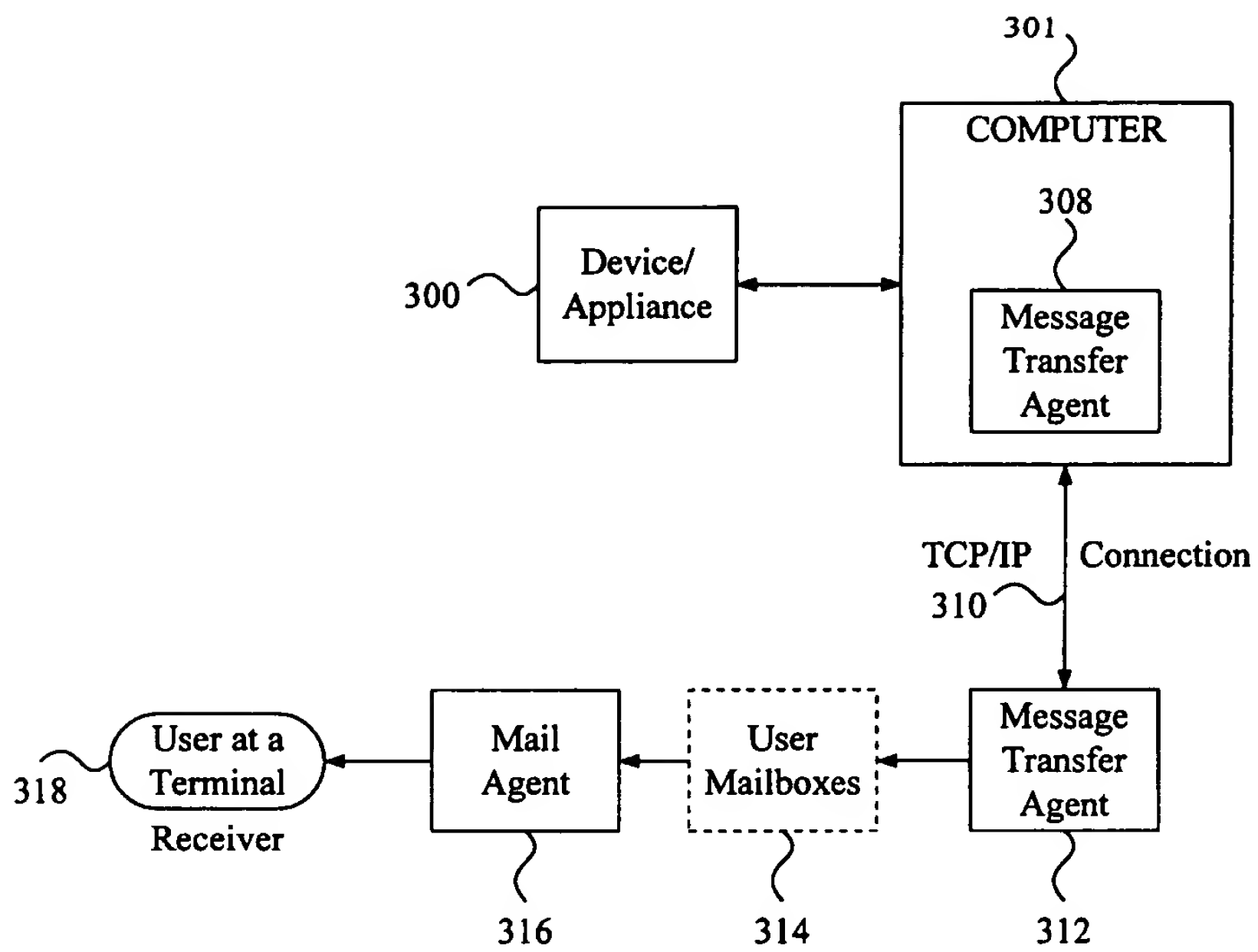


FIG. 6B

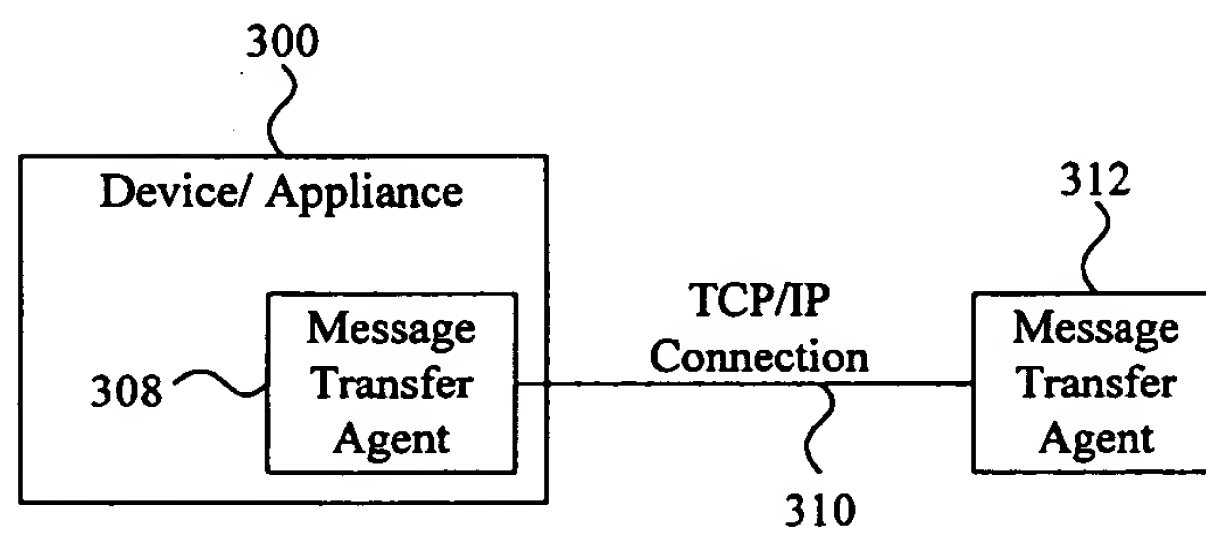


FIG. 6C

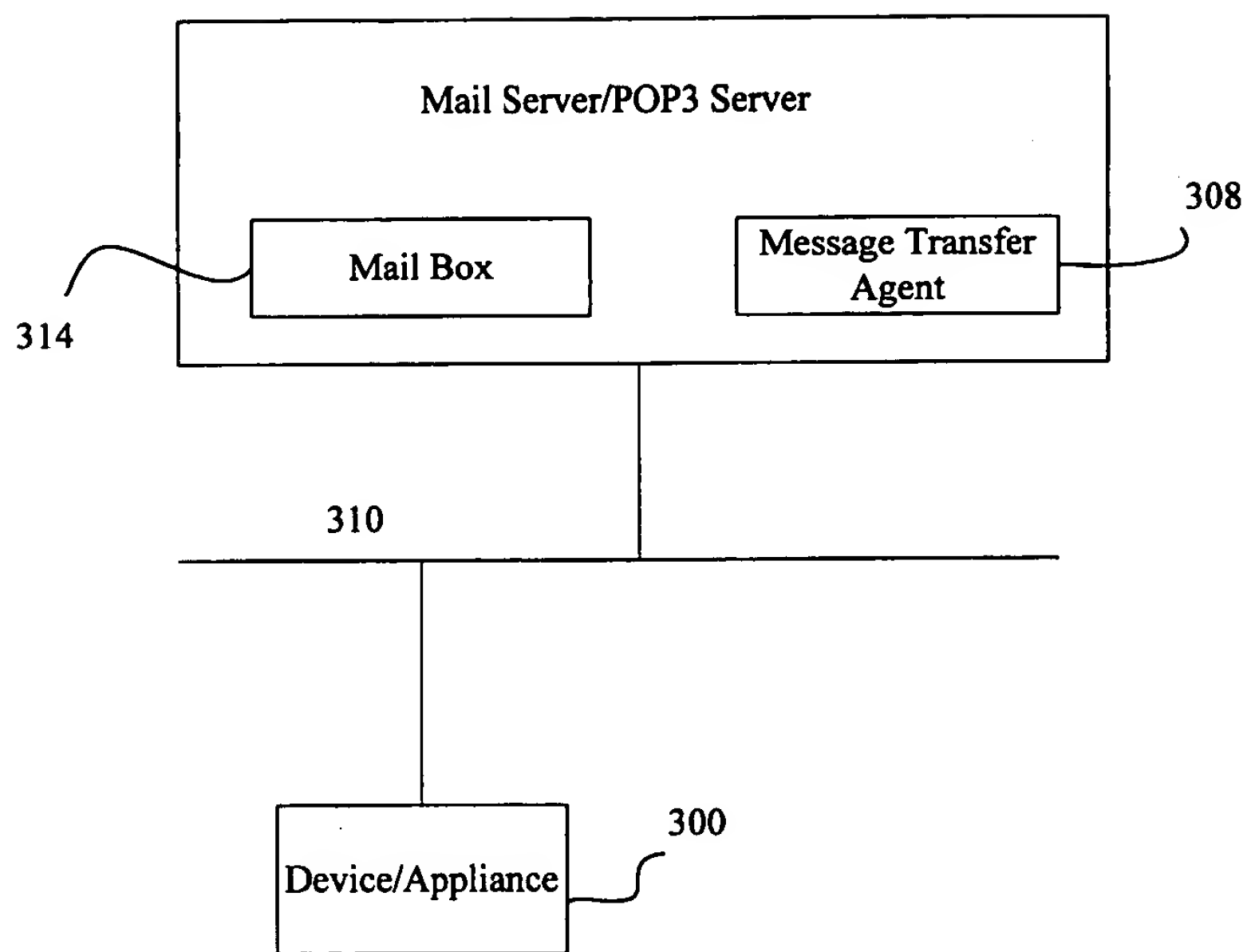


Figure 6D

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099
1990	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099

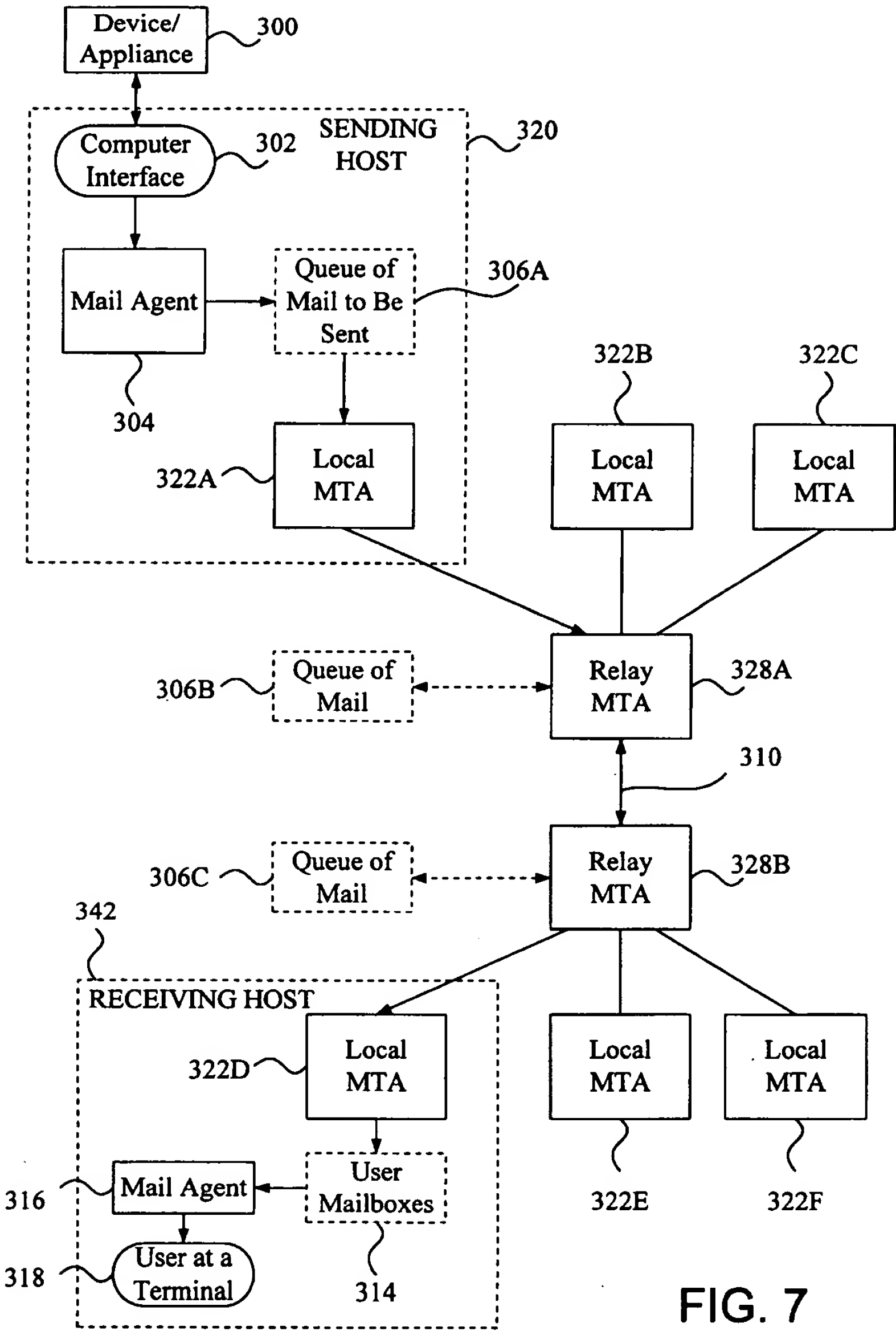


FIG. 7

SECRET

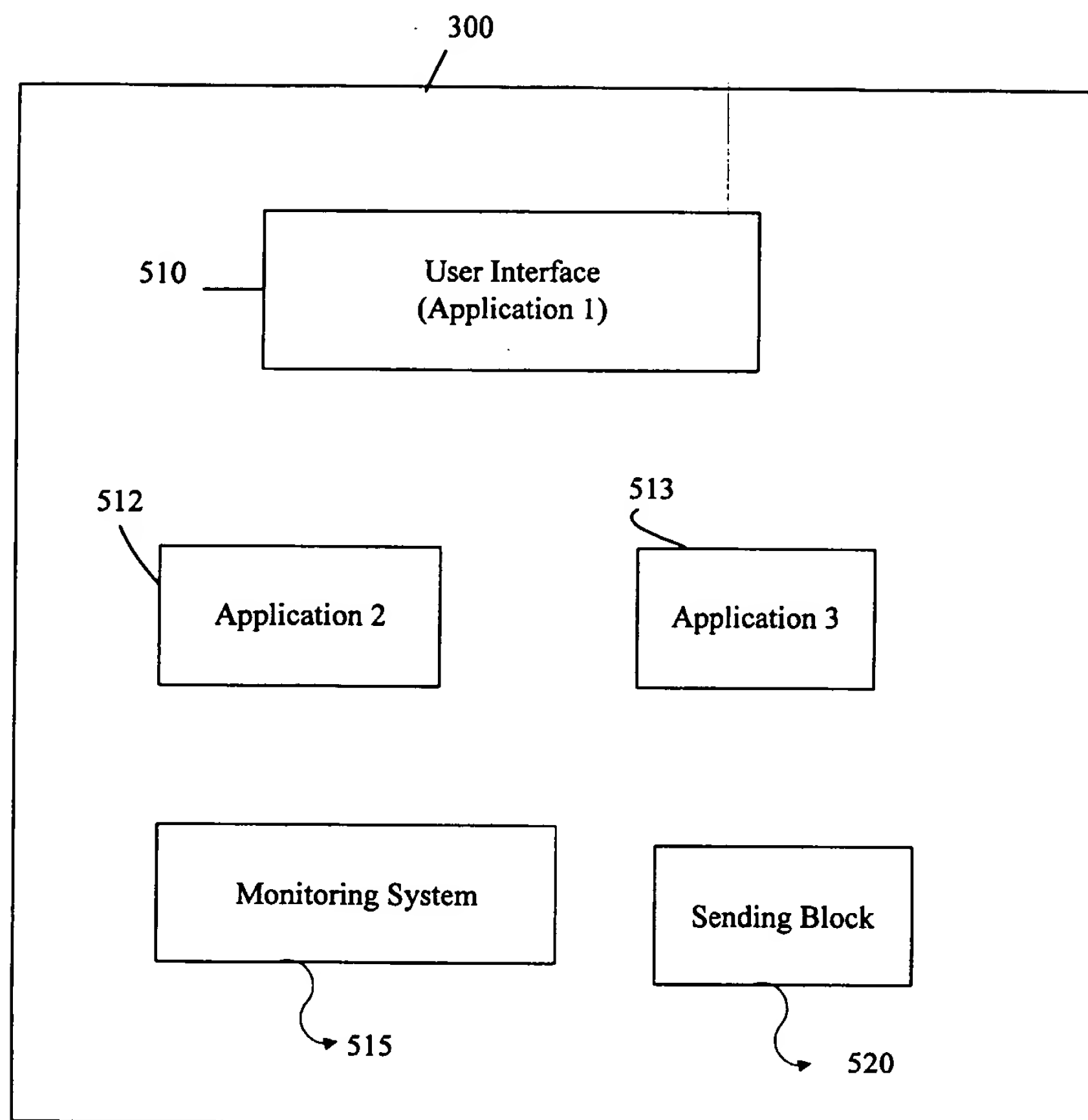


Fig. 9

Figure 10

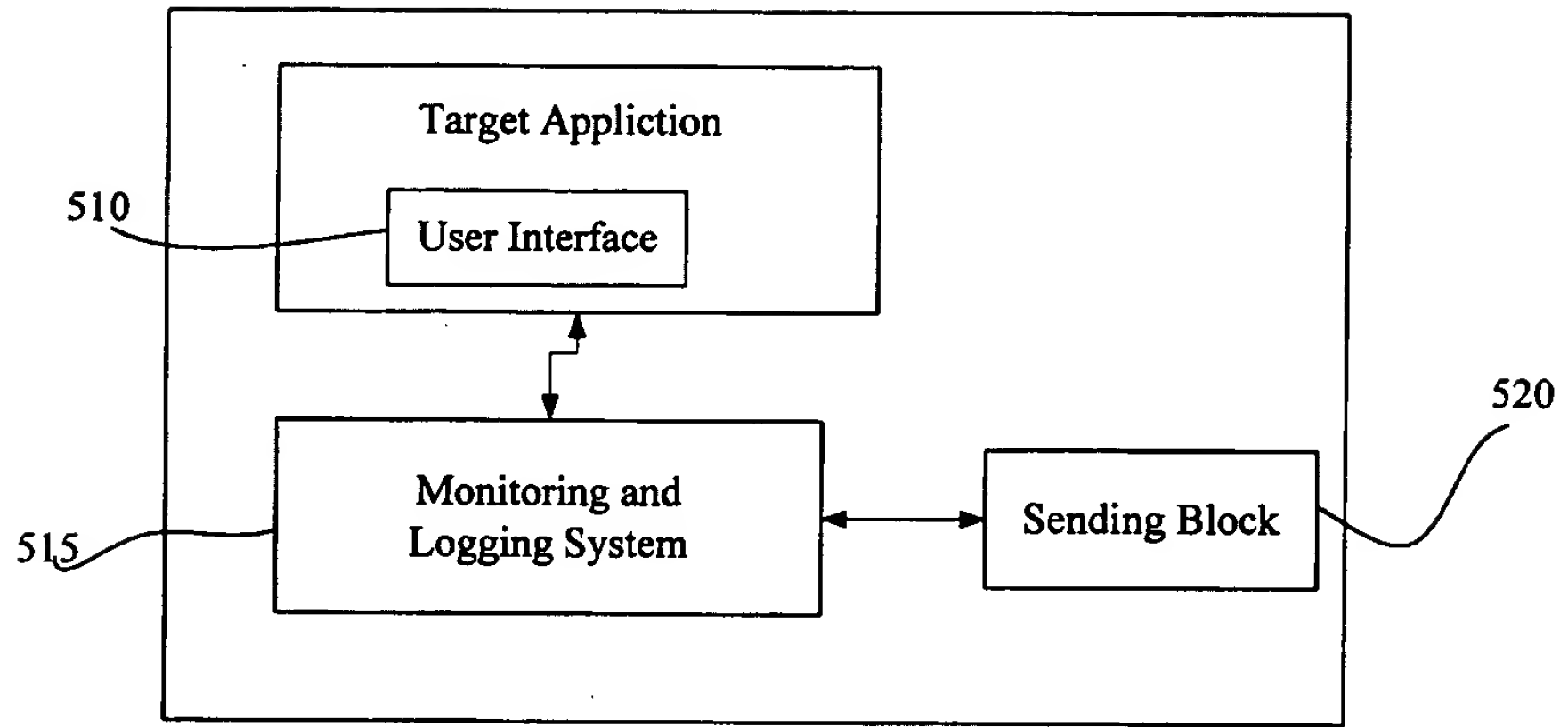
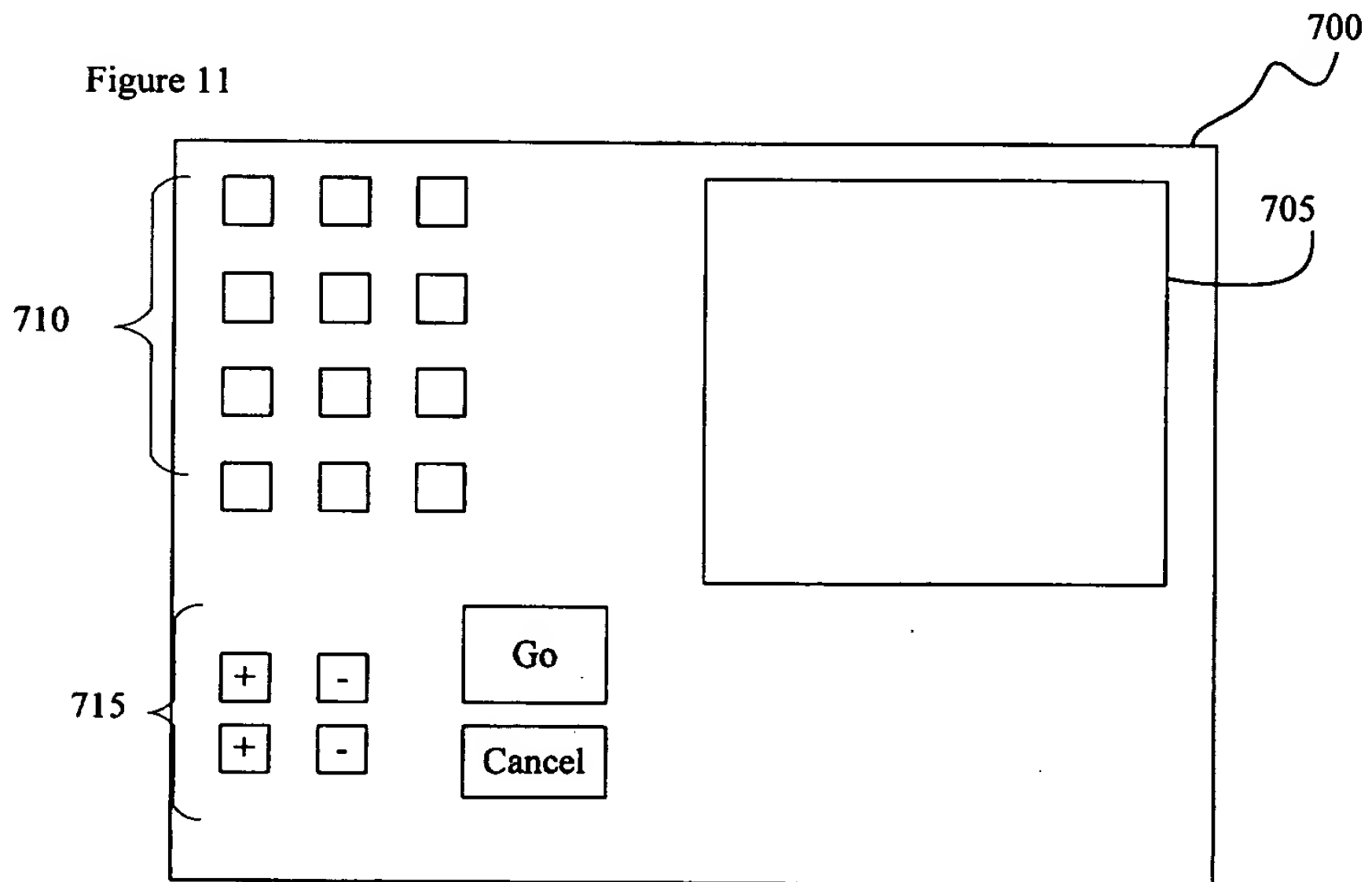


Figure 11



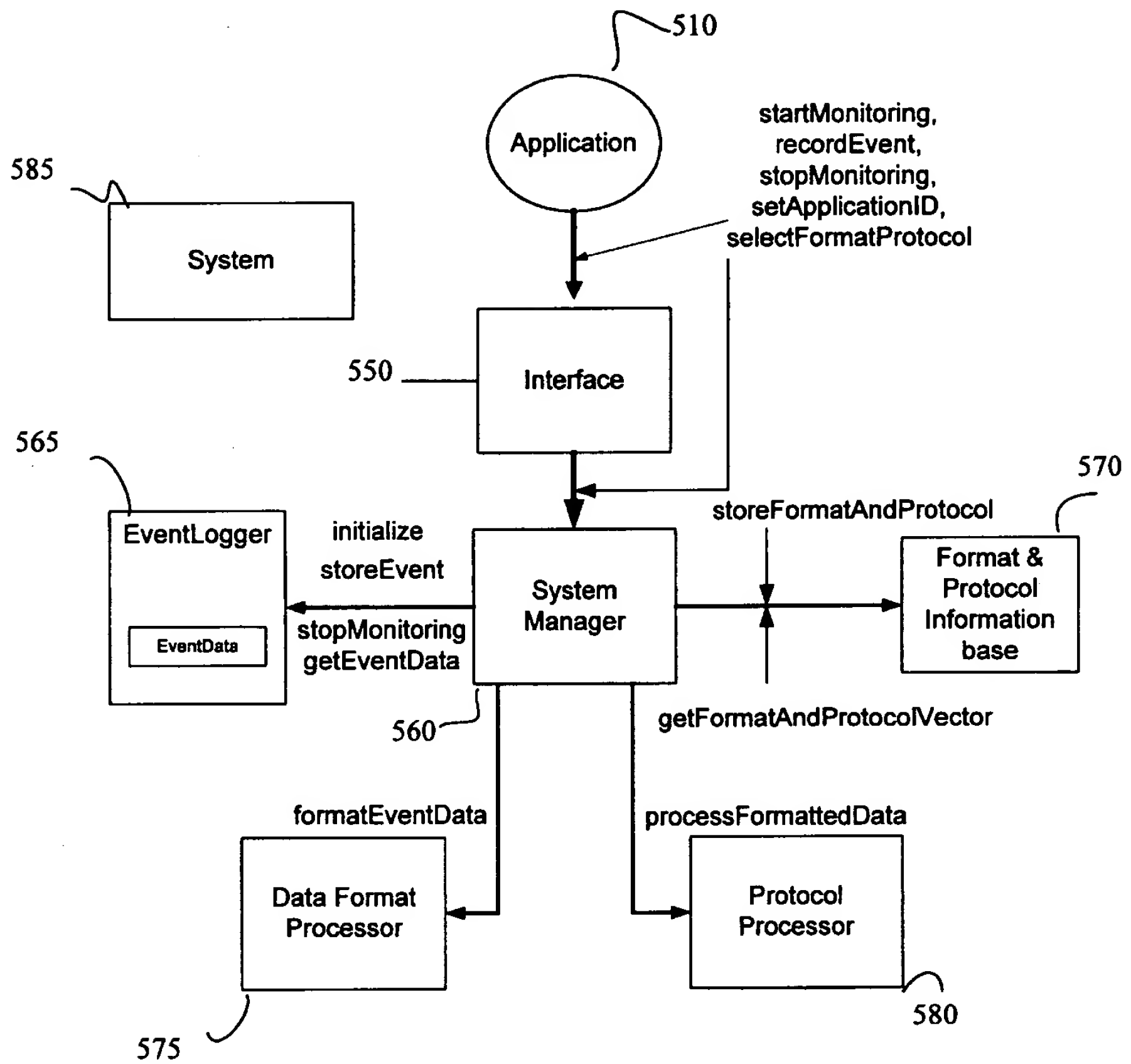


Figure 12A

Return Value	Function Name	Description
bool	getNextSession	Returns false when there is no more session; true otherwise
string	getFileName	Returns file name for the EventData
map<string, string>	getSessionInformation	Returns the map. Keys are UserID, ApplicationID, CumulativeSessionNumber, StartTime, and Duration.
map<string, vector<string>>	getSessionEventData	Returns the map. Keys are EventName and EventTiming. The values of EventTiming vector are in the unit of 10th of a second converted from unsigned integer to string.

Figure 12B

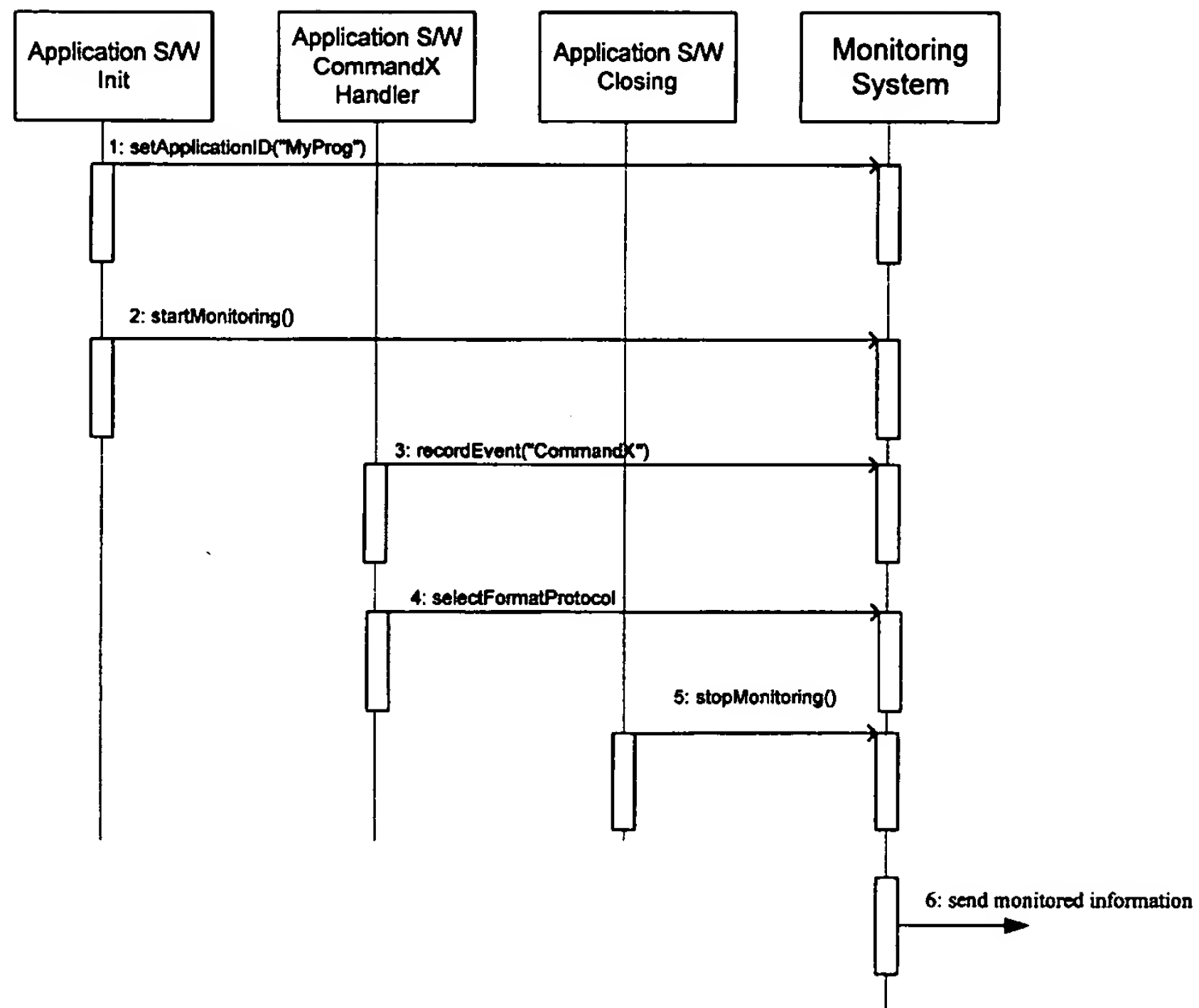
[illegible]

Figure 13

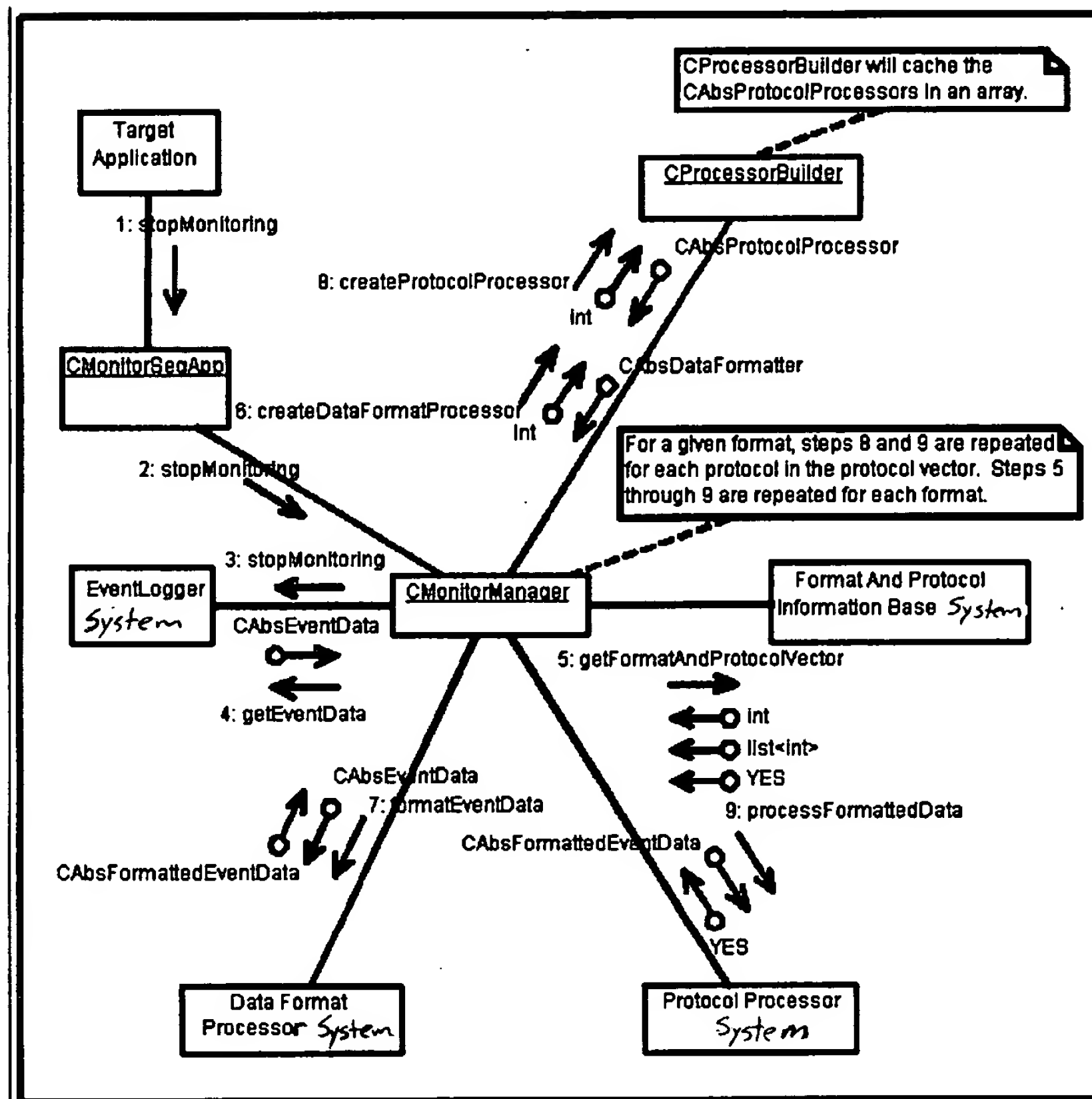
[illegible]

Figure 14

103-1640-10000

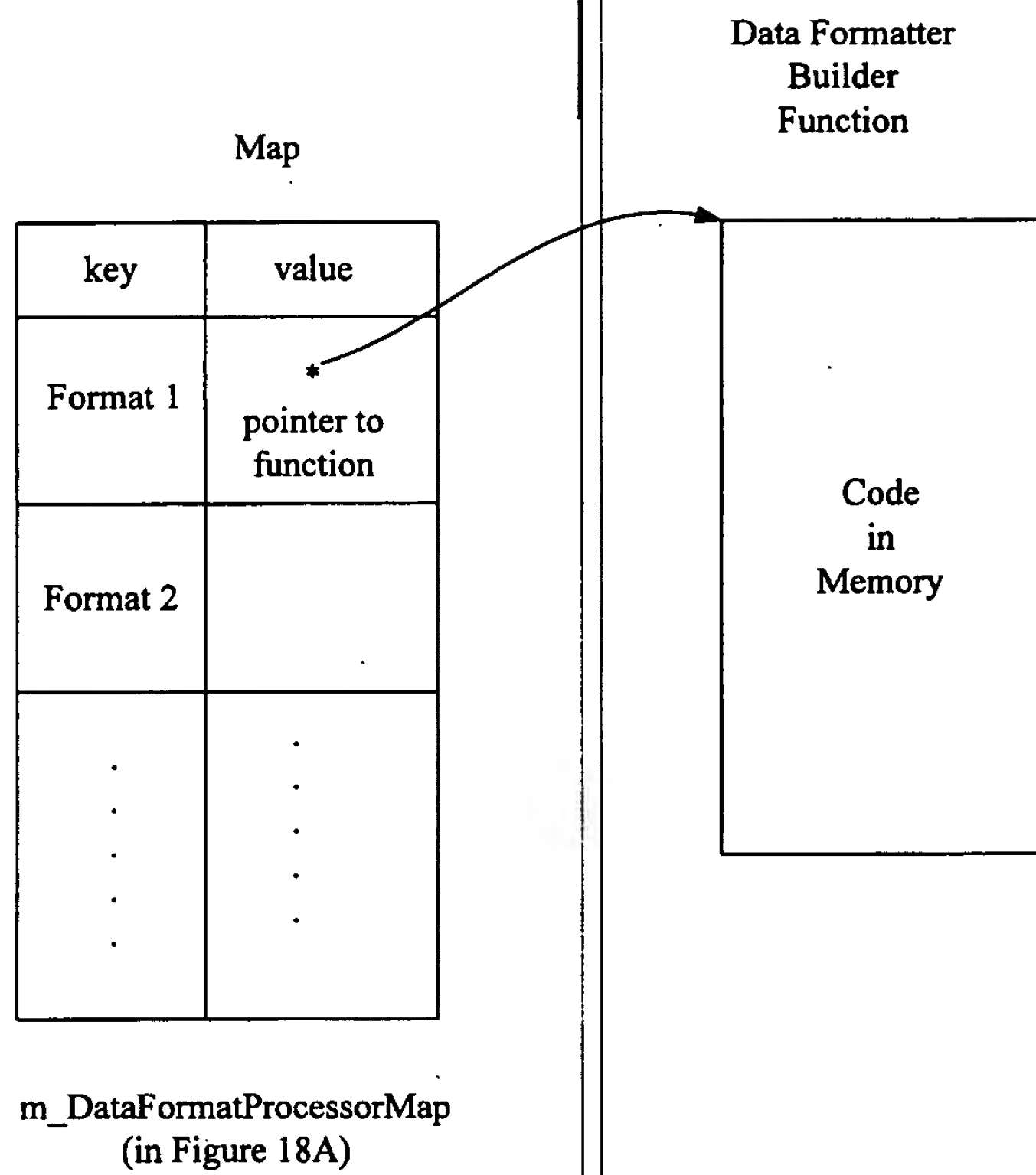


Figure 15

```

void CMonitorManager::stopMonitoring()
{
    TRACE("CMonitorManager::stopMonitoring \n");

    // 1. calls the function stopMonitoring() of
    // CUsageLogger.
    m_UsageLogger.stopMonitoring();

    // 2. calls the function getEventData() of
    // CUsageLogger. This function returns the usage
    // information, CAbsEventData, to CMonitorManager.
    CAbsEventData * loc_pAbsEventData = m_UsageLogger.getEventData();

    // 3. calls the function getFormatAndProtocolVector()
    // of CFormatProtocol_InformationBase. This function
    // returns the following to CMonitorManager: an int for
    // the data format, a list<int> for the communication
    // protocols, and a bool to indicate if the return
    // values (format and protocol) are valid.

    int loc_nFormat;
    list<int> loc_ProtocolVector;

    CProcessorBuilder loc_ProcessorBuilder;

    while(m_FormatProtocol_InformationBase.getFormatAndProtocolVector(
        loc_nFormat, loc_ProtocolVector)){

    // 4. calls the function createDataFormatProcessor()
    // of CProcessorBuilder. CMonitorManager passes an
    // int for the data format into this function. This
    // function returns the data format processor,
    // CAbsDataFormatter, to CMonitorManager.

        CAbsDataFormatter * loc_pAbsDataFormatter =
            loc_ProcessorBuilder.createDataFormatProcessor(loc_nFormat);

    // 5. calls the function formatEventData() of
    // CAbsDataFormatter. CMonitorManager passes the
    // usage information, CAbsEventData, into this
    // function. This function returns the formatted
    // usage information, CAbsFormattedEventData, to
    // CMonitorManager.

        CAbsFormattedEventData * loc_pAbsFormattedEventData =
            loc_pAbsDataFormatter->formatEventData(loc_pAbsEventData);

    // 6. calls the function createProtocolProcessor() of
    // CProcessorBuilder. CMonitorManager passes an int
    // for the communication protocol into this function.
    // The int is the first int from the protocol vector,
    // list<int>. This function returns the protocol
    // processor, CAbsProtocolProcessor, to CMonitorManager.

        for(list<int>::iterator loc_ProtocolVectorIterator =
            loc_ProtocolVector.begin(); loc_ProtocolVectorIterator NE
            loc_ProtocolVector.end(); loc_ProtocolVectorIterator ++){

```

Figure16A

```

CAbsProtocolProcessor * loc_pAbsProtocolProcessor =
    loc_ProcessorBuilder.createProtocolProcessor(
        * loc_ProtocolVectorIterator);

// 7. calls the function processFormattedData() of
// CAbsProtocolProcessor. CMonitorManager passes the
// formatted usage information, CAbsFormattedEventData,
// into this function. This function returns a bool to
// CMonitorManager to indicate if the usage information
// was communicated using the protocol.

    loc_pAbsProtocolProcessor->processFormattedData(
        loc_pAbsFormattedEventData);

}

// 8. steps 6 and 7 are repeated for each protocol,
// int, in the protocol vector, list<int>.
//
// 9. steps 3 through 8 are repeated for each format
// until the function getFormatAndProtocolVector()
// returns NO to CMonitorManager.
}

```

Figure 16B

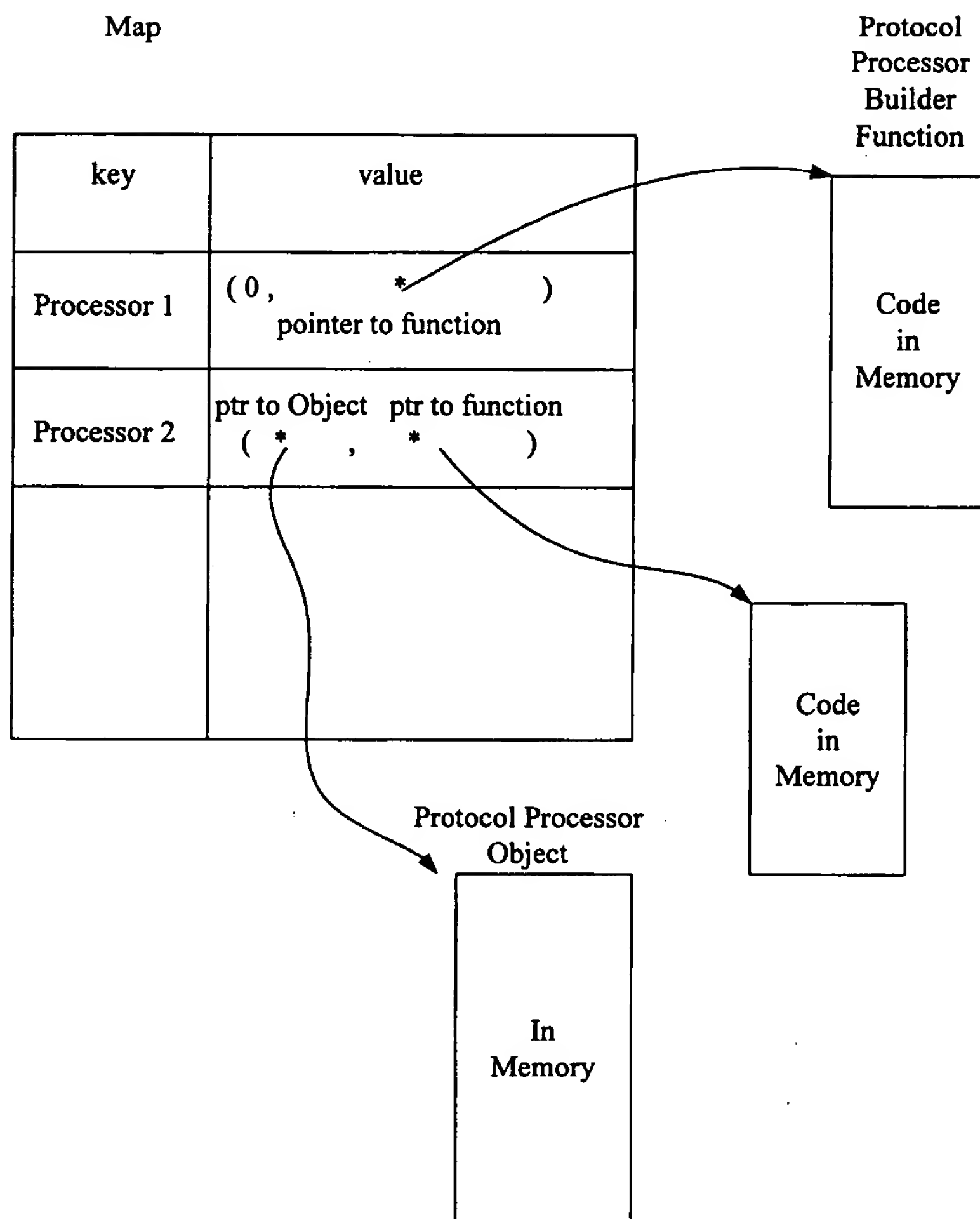


Figure 17

Author: Avery Fong
3.3 CProcessorBuilder Class Specification

3.3.1 Function List

public:
CProcessorBuilder();
~CProcessorBuilder();
CAbsDataFormatter* createDataFormatProcessor(int in_nFormat);
CAbsProtocolProcessor* createProtocolProcessor(int in_nProtocol);

private:
void initDataFormatProcessorMap();
void initProtocolProcessorMap();

Include the following functions to create the different data format processors and protocol processors.

CAbsDataFormatter* createCommaDataFormatter();
CAbsDataFormatter* createXMLDataFormatter();
CAbsProtocolProcessor* createSmtipProtocolProcessor();
CAbsProtocolProcessor* createFtpProtocolProcessor();

If new data formats or new protocols are added, then new functions to create them must be added.

Include the following typedef declarations for the functions that create the data format processors and protocol processors.

typedef CAbsDataFormatter* (*DataFormatProcessorBuilder)();
typedef CAbsProtocolProcessor* (*ProtocolProcessorBuilder)();

3.3.2 Class Attributes

Type	Attribute Name	Description
CAbsDataFormatter*	m_pDataFormatter	This attribute member points to the data format processor object. It is initialize to 0 in the constructor and the data format processor object is created by the function createDataFormatProcessor(). This function may be called multiple times so that it must delete the previous data format processor object pointed to by this attribute member before creating a new one. The destructor will delete the last data format processor object pointed to by this attribute member.
map<int, DataFormatProcessorBuilder>	m_ProtocolProcessorMap	This attribute member is a map of pointers to functions that create the data format processor. The key to this map is an int for the data format type. The value is a pointer to a function that creates the data format processor corresponding to the key. The pointers to the functions in the map are initialized in the function initDataFormatProcessorMap().
map<int, pair<CAbsProtocolProcessor*, ProtocolProcessorBuilder>>	m_ProtocolProcessorMap	This attribute member is a map of pointers to protocol processor objects and pointers to functions that create them. The key to this map is an int for the protocol processor type. The value is a pair consisting of a pointer to the protocol processor object and a pointer to a function that creates the protocol processor object. All the pointers to the protocol processor object are initialized to 0 and its corresponding functions are initialized by the function initProtocolProcessorMap(). The protocol processor objects are created by the function createProtocolProcessor(). The destructor will delete all the protocol processor objects pointed to by the map.

Figure 18A

[illegible]

Figure18B

```

/////////////////////////////////////////////////////////////////
// Private
// Function:      initDataFormatProcessorMap
// Description:   This function initializes all the function pointers
//               in the map m_DataFormatProcessorMap. If new data
//               formats are added, then this function must be
//               modified.
// Preconditions: None.
// Postconditions: None.
// Algorithm:     1. add entries to the map, m_DataFormatProcessorMap,
//               for each data format type. The key will be the
//               data format type and the value will be the pointer
//               to the corresponding function that creates the
//               data format processor.
//               2. for data format type 1, the function pointer
//               points to createCommaDataFormatter().
//               3. for data format type 2, the function pointer
//               points to createXMLDataFormatter().
/////////////////////////////////////////////////////////////////

/////////////////////////////////////////////////////////////////
// Private
// Function:      initProtocolProcessorMap
// Description:   This function initializes all the pairs of pointers
//               in the map m_ProtocolProcessorMap. If new protocols
//               are added, then this function must be modified.
// Preconditions: None.
// Postconditions: None.
// Algorithm:     1. add entries to the map, m_ProtocolProcessorMap,
//               for each protocol type. The key will be the
//               protocol type and the value will be a pointer to
//               the protocol processor object and a pointer
//               to the corresponding function that creates the
//               protocol processor. All pointers to the protocol
//               processor objects will be set to 0.
//               2. for protocol type 1, the function pointer
//               points to createSmtpprotocolProcessor().
//               3. for protocol type 2, the function pointer
//               points to createFtpProtocolProcessor().
/////////////////////////////////////////////////////////////////

/////////////////////////////////////////////////////////////////
// Function:      createCommaDataFormatter
// Description:   This function creates and returns a comma data
//               formatter object.
// Preconditions: None.
// Postconditions: The pointer to the created comma data formatter
//               object cannot be 0.
// Algorithm:     1. creates and returns an object of the class
//               CCommaDataFormatter.
/////////////////////////////////////////////////////////////////

/////////////////////////////////////////////////////////////////
// Function:      createXMLDataFormatter
// Description:   This function creates and returns an XML data
//               formatter object.
// Preconditions: None.
// Postconditions: The pointer to the created XML data formatter
//               object cannot be 0.
// Algorithm:     1. creates and returns an object of the class
//               CXMLDataFormatter.
/////////////////////////////////////////////////////////////////

```

Figure 18C


```

////////////////////////////////////
// Function:      createSmtplibProtocolProcessor
// Description:    This function creates and returns an SMTP protocol
//                processor object.
// Preconditions:  None.
// Postconditions: The pointer to the created smtp protocol processor
//                object cannot be 0.
// Algorithm:      1. creates and returns an object of the class
//                CSmtplibProtocolProcessor.
////////////////////////////////////

```

```

////////////////////////////////////
// Function:      createFtpProtocolProcessor
// Description:    This function creates and returns an FTP protocol
//                processor object.
// Preconditions:  None.
// Postconditions: The pointer to the created ftp protocol processor
//                object cannot be 0.
// Algorithm:      1. creates and returns an object of the class
//                CFtpProtocolProcessor.
////////////////////////////////////

```

Figure 18D

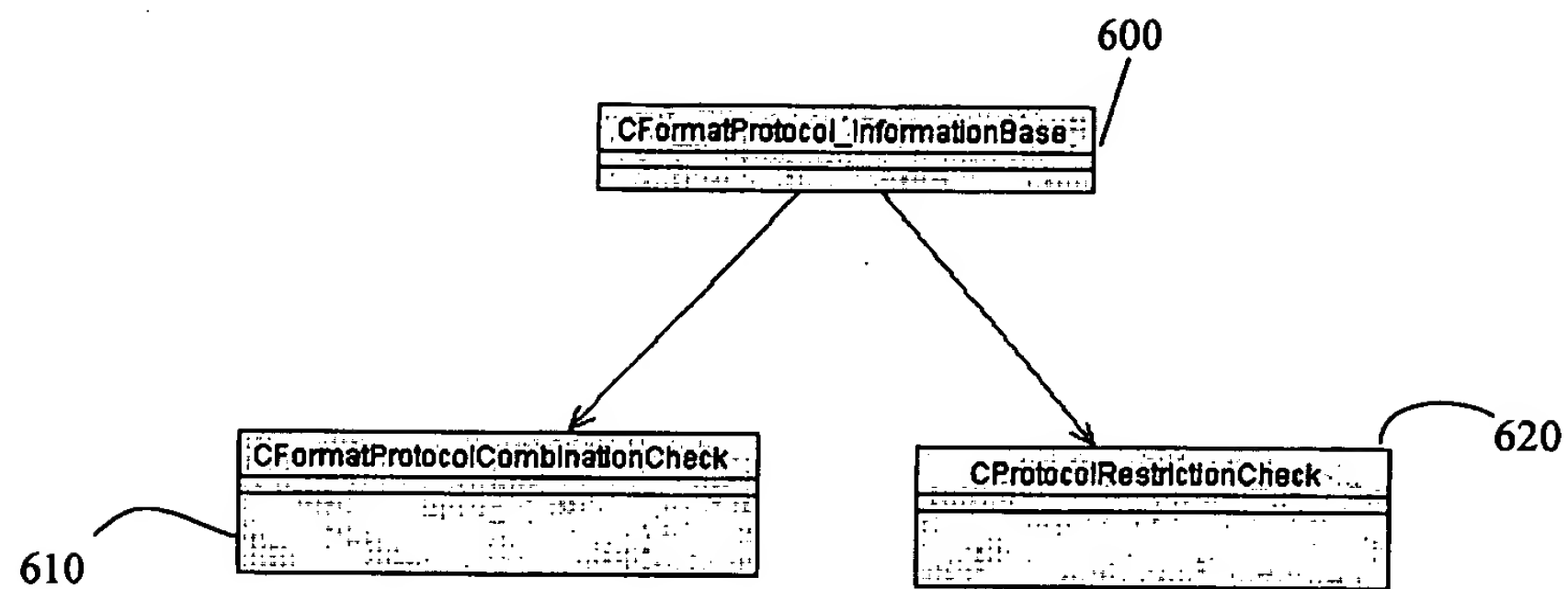
```
sequenceDiagram
    participant TA as Target Application
    participant CMA as CMonitorSeqApp
    participant CMM as CMonitorManager
    participant FPIB as Format & Protocol Information Base: System

    TA->>CMA: int Int 1: selectFormatProtocol
    CMA->>CMM: int Int 2: selectFormatProtocol
    CMM->>FPIB: int Int 3: storeFormatAndProtocol
```

The diagram illustrates a sequence of interactions between four components:

- Target Application** sends a message `int Int 1: selectFormatProtocol` to **CMonitorSeqApp**.
- CMonitorSeqApp** sends a message `int Int 2: selectFormatProtocol` to **CMonitorManager**.
- CMonitorManager** sends a message `int Int 3: storeFormatAndProtocol` to **Format & Protocol Information Base: System**.

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Format And Protocol Information Base Package Class Structure

Figure 20

SECRET

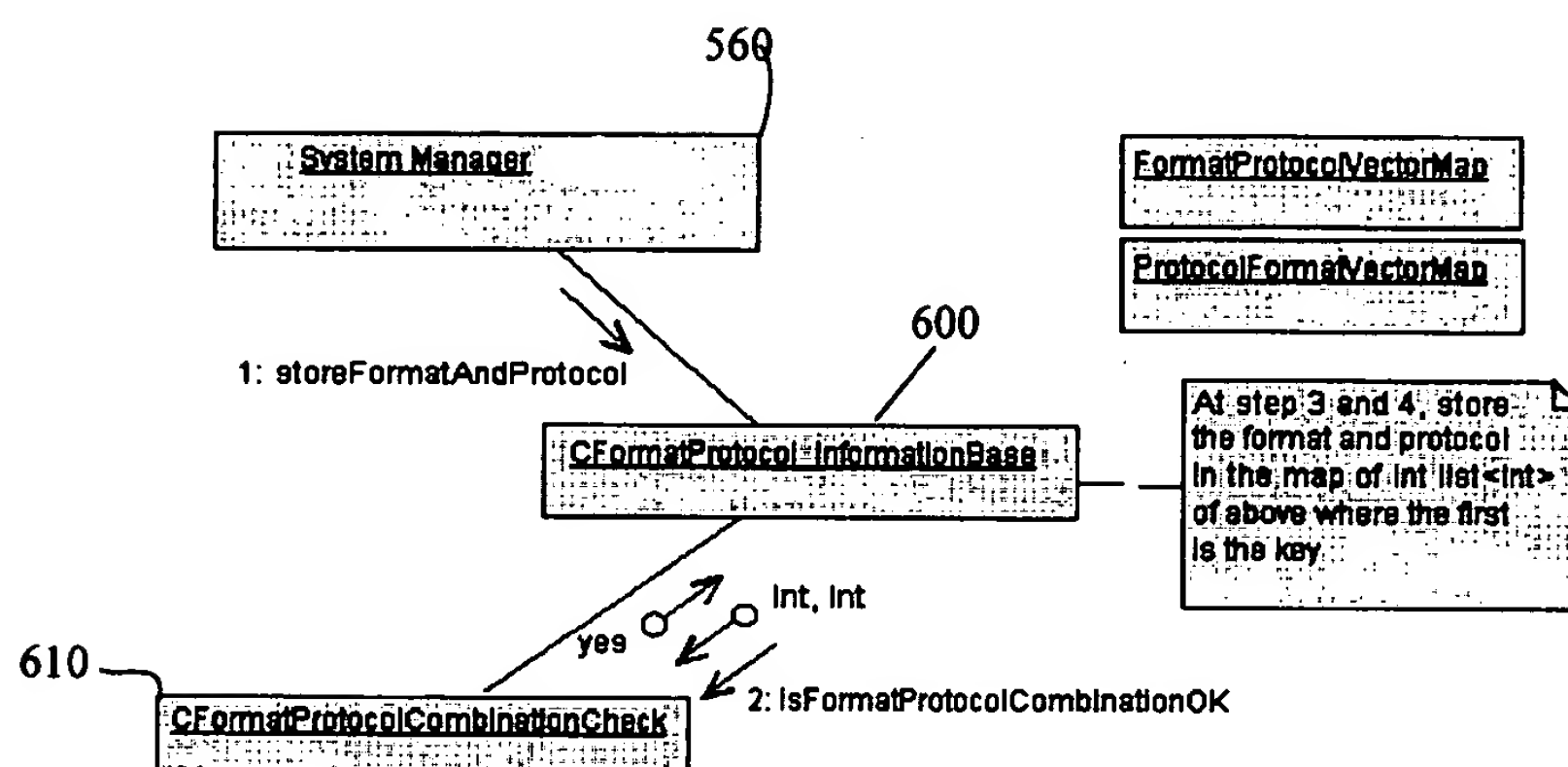


Figure 21

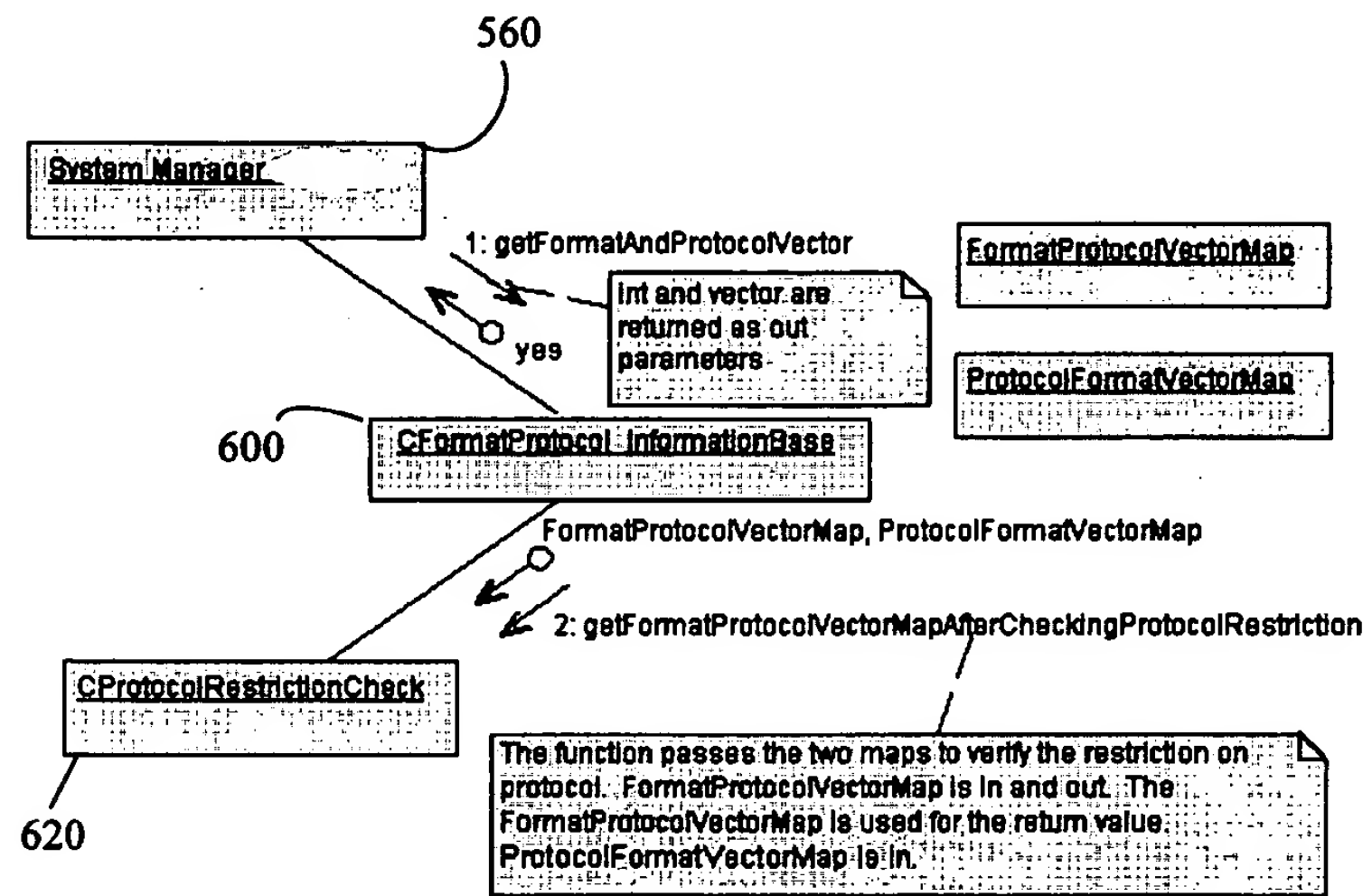


Figure 22

Author: Tetsuro Motoyama

5.2 CFormatProtocol_InformationBase Class Specification

5.2.1 Function List

```
public:
    CFormatProtocol_InformationBase();
    ~CFormatProtocol_InformationBase();
    void storeFormatAndProtocol(int in_nFormat, int in_nProtocol);
    bool getFormatAndProtocolVector(int & out_nFormat, list<int> & out_ProtocolVector);

private:
    void setDefaultFormatAndProtocol();
```

5.2.2 Class Attributes

Type	Attribute Name	Description
map<int, list<int> >	m_FormatProtocolVectorMap	The key is a format value, and the list is the list of protocol values associated to the key. Because subscripting [] is not needed in this implementation, list is used for the vector implementation. This map is used to return the necessary information for getFormatAndProtocolVector function Note: > > is > space > to distinguish from ">>" that is used by ostream.
map<int, list<int> >	m_ProtocolFormatVectorMap	The key is a protocol value, and the list is the list of format values associated to the key. Because subscripting [] is not needed in this implementation, list is used for the vector implementation. This map is used to modify the map above if the protocol can take only one format.
bool	m_bFirstGetCall	This flag is used to call the function in CProtocolRestrictionCheck. The constructor set this to be true. The function, getFormatAndProtocolVector, sets it to be false
map<int, list<int> >::iterator	m_FormatProtocolVectorMapIterator	Iterator used to iterate the map.
CFormatProtocolCombinationCheck	m_FormatProtocolCombinationCheck	This object is to check the combination of format and protocol
CProtocolRestrictionCheck	m_ProtocolRestrictionCheck	This object is to check the protocol restriction. Currently, the only restriction is if protocol can have only one format support.

5.2.3 Function Definitions

```
////////////////////////////////////
//Function:      CFormatProtocol_InformationBase
//Description:   ~Constructor
//Preconditions:  None
//Postconditions: None
//Algorithm:     Set m_bFirstGetCall to true
////////////////////////////////////

////////////////////////////////////
//Function:      ~CFormatProtocol_InformationBase
//Description:   Destructor
//Preconditions:  None
//Postconditions: None
//Algorithm:     Default
////////////////////////////////////
```

Figure 17A
23A

```

////////////////////////////////////
//Function:      storeFormatAndProtocol
//Description:    Check the passed format and protocol values
//                to be valid or not. If valid, store the
//                values into the two maps
//Preconditions:  None
//Postconditions: None
//Algorithm:      1. Send two values to check the combination
//                through isFormatProtocolCombinationOK
//                function.
//                2. Check the return bool value.
//                3. If yes, save format and protocol values
//                into two maps (Figure 5.4 of the
//                Specification, Q6-DJ04-08)
//                Else, do nothing.
////////////////////////////////////

```

```

////////////////////////////////////
//Function:      getFormatAndProtocolVector
//Description:    The function returns a format and a list
//                of protocol values associated with the
//                format through two parameters. The function
//                returns true if a format and list are
//                returned, false otherwise.
//Preconditions:  None
//Postconditions: The format value is within the range.
//                The list is not empty and contains the values
//                within the range.
//Algorithm:      1. If m_bFirstGetCall (Figure 5.5 of the
//                Specification Q6-DJ04-08)
//                1.1 call the function to check the protocol
//                restriction.
//                1.2 check if m_FormatProtocolVectorMap is
//                empty. If empty, set it to default
//                values of format and protocol by calling
//                setDefaultFormatAndProtocol function.
//                1.3 set the iterator to begin().
//                1.4 set m_bFirstGetCall to be false
//                2. If iterator is end, return false.
//                else (Figure 5.6 of the Specification
//                Q6-DJ04-08)
//                get format and list to return and set
//                return parameters.
//                increment iterator.
//                Return true.
////////////////////////////////////

```

```

////////////////////////////////////
//Private Function: setDefaultFormatAndProtocol
//Description:      The function sets the default values for
//                format and protocol in the map.
//Preconditions:    The m_FormatProtocolVectorMap is empty.
//Postconditions:   The map contains one default format and a
//                protocol list with one default protocol.
//Algorithm:        Set the map with the default values.
////////////////////////////////////

```

Figure 172
23B

Author: Tetsuro Motoyama

5.3 CFormatProtocolCombinationCheck Class Specification

5.3.1 Function List

```
public:
    CFormatProtocolCombinationCheck();
    ~CFormatProtocolCombinationCheck();
    bool isFormatProtocolCombinationOK(const int in_nFormat, const int in_nProtocol);

private:
    void initMatrix();
```

5.3.2 Class Attributes

Type	Attribute Name	Description
map<int, set<int> >	m_CombinationMatrix	Key is the format. The set contains the protocols that are valid for the particular format

5.3.3 Function Definitions

```
////////////////////////////////////
//Function:      CFormatProtocolCombinationCheck
//Description:    Constructor
//Preconditions:  None
//Postconditions: None
//Algorithm:      call initMatrix
////////////////////////////////////
```

```
////////////////////////////////////
//Function:      ~CFormatProtocolCombinationCheck
//Description:    Destructor
//Preconditions:  None
//Postconditions: None
//Algorithm:      Default
////////////////////////////////////
```

```
////////////////////////////////////
//Function:      isFormatProtocolCombinationOK
//Description:    Check the passed format and protocol values
//                to be valid or not. If valid, return yes,
//                no otherwise
//Preconditions:  None
//Postconditions: None
//Algorithm:      1. Use find function of the Matrix for
//                in_nFormat
//                2. If returned iterator is end, return No
//                3. get the set value for the key format
//                4. Use the find function of the set for
//                in_nProtocol
//                5. if returned iterator is end, return no
//                6. return yes
////////////////////////////////////
```

Figure 18A
24A


```
////////////////////////////////////  
//Private Function:  initMatrix  
//Description:       This function initializes m_CombinationMatrix.  
//                  If new formats or protocols are added, this  
//                  function must be modified.  
//  
//Precondition:      None  
//Postcondition:     None  
//Algorithm:         1. Create the local set<int>  
//                  2. for each format  
//                      2.1 fill in the local set  
//                      with the protocol numbers  
//                      that are valid for the format,  
//                      using insert function  
//                  2.2 m_CombinationMatrix[format]  
//                      = local set  
//                  2.3 clear local set  
////////////////////////////////////
```

Figure 18B
24B

Author: Tetsuro Motoyama

5.4 CProtocolRestrictionCheck Class Specification**5.4.1 Function List**

```

public:
    CProtocolRestrictionCheck();
    ~CProtocolRestrictionCheck()
    void getFormatProtocolVectorMapAfterCheckingProtocolRestriction
        (map<int, list<int>> & inOut_Map, const map<int, list<int>> & in_Map);

private:
    void initOneFormatRestriction();
    void oneFormatRestriction
        (map<int, list<int>> & inOut_Map, const map<int, list<int>> & in_Map);

```

5.4.2 Class Attributes

Type	Attribute Name	Description
vector<bool>	m_bOneFormatRestriction	Array size should be protocol size+1. The position corresponds to the protocol.

5.4.3 Function Definitions

```

////////////////////////////////////
//Function:      CProtocolRestrictionCheck
//Description:   Constructor
//Preconditions:  None
//Postconditions: None
//Algorithm:     call initOneFormatRestriction
////////////////////////////////////

////////////////////////////////////
//Function:      ~CProtocolRestrictionCheck
//Description:   Destructor
//Preconditions:  None
//Postconditions: None
//Algorithm:     Default
////////////////////////////////////

////////////////////////////////////
//Function:      getFormatProtocolVectorMapAfterCheckingProtocolRestriction
//Description:   Check the restriction on the protocol.
//              Currently, there is only one possible restriction
//              defined in the requirements. If there are more
//              restrictions, more private functions should be
//              added and called.
//Preconditions:  None
//Postconditions: None
//Algorithm:     1. Call oneFormatRestriction function
////////////////////////////////////

```

Figure 19A
25A

```

//Private Function: initOneFormatRestriction
//Description: This function initialize the attribute
//              m_bOneFormatRestriction. If more protocols are
//              added, this initialization must be modified.
//Preconditions: None
//Postconditions: None
//Algorithm: 1. use assign(size+1,false) to initialize the
//            vector to false.
//            2. set the entries of true.
//            Note: for class debug version, use
//                  ifdef and
//                  bool & pos1 = m_bOneFormatRestriction[1];
//                  bool & pos2 = m_bOneFormatRestriction[2];
//                  and so on to be able to see and to
//                  change the value.
//            //////////////////////////////////////

////////////////////////////////////
//Private Function: oneFormatRestriction
//Description: This function receives two maps and if the one
//              restriction is true for given protocol, the
//              content of inOut_Map (m_FormatProtocolVectorMap)
//              is adjusted accordingly.
//Preconditions: None
//Postconditions: None
//Algorithm: Iterate over the in_Map (m_ProtocolFormatVectorMap)
//            1. get the key (pkey)
//            2. If m_bOneFormatRestriction[pkey]
//               2.1 Get the value list of in_Map for the key
//               2.2 local int lastFormat = back(),
//               2.3 iterate over the list
//                   if *iterator NE lastFormat
//                       iterate over inOut_Map[*iterator] list
//                           if the value EQ pkey
//                               erase the entry from the list
//            3. Iterate over inOut_Map
//               if value list is empty,
//                   erase the entry from inOut_Map
//            -----
//Example:
//          0 1 2 3 4
//          m_bOneFormatRestriction = {0,0,1,0,1} (four protocols)
//          0: false, 1: true
//          inOut_Map (m_FormatProtocolVectorMap)
//          = { 1, <1,2,3,4> --> <1, 2, 3>
//            2, <2,1,3,4> --> <1, 3>
//            3, <3,4,1,2> --> <3, 4, 1>
//            4, <2,4> --> <>
//          in_Map (m_ProtocolFormatVectorMap)
//          = { 1, <1, 3, 2>
//            2, <4, 3, 2, 1>
//            3, <1, 3, 2>
//            4, <4, 2, 1, 3>
//          }
//          pkey = 1 m_bOneFormatRestriction[1] = 0
//          pkey = 2 m_bOneFormatRestriction[2] = 1
//          value list = <4, 3, 2, 1> (2.1)
//          lastFormat = 1 (2.2)
//          4 != 1
//          inOut_Map[4] = <2,4>
//          erase value 2 <4>
//          3 != 1
//          inOut_Map[3] = <3,4,1,2>
//          erase value 2 <3,4,1>
//          2 != 1
//          inOut_Map[2] = <2,1,3,4>
//          erase value 2 <1,3,4>
//          1 == 1
//          pkey = 3 m_bOneFormatRestriction[3] = 0

```

Figure 19A3
25B

```

// pkey = 4 m_bOneFormatRestriction[4] = 1
// value list = <4, 2, 1, 3>
// lastFormat = 3
// 4 != 3
//   inOut_Map[4] = <4>
//   erase value 4 <>
// 2 != 3
//   inOut_Map[2] = <1,3,4>
//   erase value 4 <1,3>
// 1 != 3
//   inOut_Map[1] = <1,2,3,4>
//   erase value 4 <1,2,3>
// 3 == 3
// Iterate over inOut_Map
//   if *inOut_Map_iterator.empty() then erase
//
// inOut_Map
//   = ( 1, <1, 2, 3>
//       2, <1, 3>
//       3, <3, 4, 1>)
//
////////////////////////////////////

```

Figure 19C
25C